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ABSTRACT

Research concerning the applied educational potential of Richard Atkinson's mnemonic "keyword method" is reported in this paper. Included are possibilities for stretching the limits of the keyword method by combining it with other mnemonic and prose-learning strategies. The first half of the paper provides an overview of mnemonics--the systems' historical development into the keyword method--and discusses various mnemonic applications. The second half of the paper discusses the following reasons for introducing mnemonic techniques into educational curricula: (1) students remember more information in comparison to those who do not use mnemonic techniques, (2) mnemonic effects are potent and durable, (3) the techniques are versatile and can work in a classroom context, (4) use of mnemonic techniques will not impede the acquisition of other valued skills and may help to foster certain valued skills, (5) mnemonics are adaptable to student differences, (6) most children enjoy using mnemonics, and (7) many teachers believe in the value of mnemonics. Four pages of references conclude the document. (HOD)

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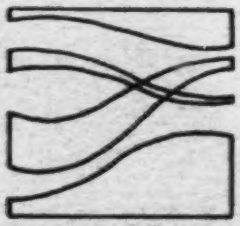

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The Mnemonic '80s: Keywords in the Classroom

by Joel R. Levin

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September 1980

Wisconsin Research and Development
Center for Individualized Schooling

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by

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Report from the Project on
Studies in Language: Reading and Communication

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Abstract

Research concerning the applied educational potential of Richard Atkinson's mnemonic "keyword method" is reported. Included are possibilities for stretching the limits of the keyword method by combining it with other mnemonic and prose-learning strategies. Ten reasons are given for why mnemonic techniques should be introduced into educational curricula.

This is a report on mnemonic techniques. Mnemonic techniques, also commonly referred to as mediational strategies, are methods that improve one's learning, memory, and maybe even comprehension. As such, mnemonic techniques are typically applied to information that is difficult to learn, remember, or comprehend. Although several mnemonic techniques exist that are primarily verbal in nature, the ones I will discuss here rely heavily on the use of pictures (illustrations and visual images). As has been argued elsewhere (e.g., Levin, in press; Paivio, 1971), pictures may be especially useful vehicles for transporting information that is to be coded mnemonically.

But why should mnemonic techniques matter at all to educational psychologists? They certainly matter to me, because I've been looking for the appropriate forum to introduce two exciting new strategies that we have discovered in our research with children. One of these was unearthed at a parochial school where, when asked about the kind of strategy he had applied to learn a list of words, a child responded: "I prayed really hard to the Lord to help me remember." Thus, it appears that in addition to verbal and imagery mediation in memory, there now is a place for divine mediation (Pressley & Bender, Note 1). A second revelation occurred when the youngest daughter of one of my graduate assistants, upon applying a memory strategy to a homework assignment, reported to her teacher that she had learned the material by using demonics (Shriberg, Note 2). I guess that means we're going to have to work hard at developing appropriate memory exorcizes as well.

On the more serious side of things, however, mnemonics should matter to educational psychologists. Ten years ago, Gordon Bower remarked at the annual meeting of the American Educational Research Association that:

> ...applications [of mnemonics in educational settings] should proceed with all deliberate speed. In my opinion, the educational potential of applying mnemonics is about as great today as was the potential of programmed instruction 15 years ago. In other words, I'm convinced there's much educational gold in these hills (Bower, Note 3, p. 12).

A few years later, in an invited address delivered at the annual meeting of the American Psychological Association, Richard Atkinson described a mnemonic technique that he had been experimenting with in college-level foreign language classes. He concluded that his research:

> ...has not led to any new theoretical insights or even to experiments that have direct relevance to current issues in the psychology of memory. But the research illustrates the steps necessary to take an idea that emerged in the confines of an experimental psychologist's laboratory and develop it to a point at which it can be used in a practical teaching situation (Atkinson, 1975, p. 828).

In this report, I will launch an attack on Bower's and Atkinson's concerns. That is, I will confine my attention primarily to educational applications of mnemonic techniques, with an eye toward mining some of the gold in those hills. In addition, however, I am equally confident that a number of interesting "psychological sidelights" will surface during the course of our discussion. In this sense, it will become readily apparent that just as psychology can inform educational practice, so can educational practice inform psychology.

Mnemonic Overview

The first item on my agenda is to provide a relevant "schema" within which to frame our discussion of mnemonics. This brief historical sketch will include little more than an allusion to the sources where the "serious student" can obtain more information. Invariably, a mnemonic journey begins with the mnemonic ancients.

The Mnemonic Ancients

Detailed accounts of the mnemonic systems used by the ancient Greeks and Romans are found in the writings of Paivio (1971), Wittrock (1975), Yates (1966), and others. The most relevant point, for present purposes, is that the basic components of the memory systems used then have remained pretty much intact today. For example, now as then, visual imagery comprises a critical ingredient of many such systems. Similarly, the principle of relating newly acquired information to well-established "hooks" or "pegs" has lived on, as has the notion that overlearned sequences of objects, events, or places must be built into the system if one wants to retrieve information in some kind of orderly fashion. Thus, just as a Roman statesman could,

by taking an imaginary walk along the Appian Way, eloquently argue the likely consequences of engaging in a particular battle, today's student of Roman history can easily recount the actual consequences of that battle by taking a similar mental stroll across the campus.

The Mnemonic "Experts"

But that was ancient history. From a discussion of commonly shared mnemonic systems we move on to the study of individuals with phenomenal idiosyncratic memory systems of their own (see, for example, Crovitz, 1970; Luria, 1968). Most recently, Science magazine documented the case of S. F. (Ericsson, Chase, & Faloon, 1980). This college student, with "average" memory ability, learned to recall strings of up to 79 digits in order by applying idiosyncratic mnemonic strategies. An avid long-distance runner, he grouped digits according to times for various distances in combination with the ages of imagined participants. I have my own mnemonist acquaintance (T. W.), a golf fanatic, who uses a similar digit-span strategy based on a strokes-per-hole coding of familiar golf courses.

Another type of "expert" testimony begins as an introspective analysis, and ends up on a shelf in your favorite bookstore with a title such as Improving Your Memory for Fun and Profit. Accounts of this kind reflect a proselytizing (and, yes, Barnum-like) philosophy captured by: "Boy, do I have a system for you!" The fundamental problem I have with such systems is that they are scientifically untested. For example, most commercialized self-help mnemonic systems come equipped with multiple components and prescriptions. Without any scientific data, however, one can only hazard a guess

as to precisely which aspects of the system--if any--are beneficial. A case in point: For many, many years, popular folklore has told us that in order for an imagery mnemonic system to be effective, the images generated must be extremely unusual or bizarre. Consider, for example, the admonitions appearing in a recent popular memory book:

> In Order to Remember Any New Piece of Information, It Must Be Associated to Something You Already Know or Remember in Some Ridiculous Way...you need a ridiculous--impossible, crazy, illogical, absurd--picture or image to associate the two items. What you don't want is a logical or sensible picture (Lorayne & Lucas, 1974, p. 9).

Fortunately for our profession, we can now disregard this advice. Why? Because based on numerous studies in which bizarreness has been systematically manipulated, there is no convincing support for the claim that "bizarre is better." In contrast, research does support the claim that clearly visualized or vivid images are more memorable than weak ones and, so, from a scientific standpoint it can be stated succinctly: vividness, si; bizarreness, no (see, for example, Higbee, 1979, and Paivio, 1971).

An even more extreme example of the problem is manifested by the popular mnemonist's assumption that "what works for me will work for you." Once again, I would require some sort of objective data for evaluating the "goodness" of various mnemonic systems and materials. As we found out in a recent study I will describe later, what works

for the author may work only for the author. In such instances, the public is clearly being sold a bad bill of goods.

The Mnemonic Researchers

From those who use mnemonics, we move on to those who research mnemonics. Especially significant contributions to this area have resulted from the research programs of Gordon Bower (1972), Allan Paivio (1971), and William Rohwer (1973). In this regard, it is noteworthy that the bulk of theoretical and experimental analyses of mnemonic components has occurred within the last 15 years. As such, we have only recently begun to learn why mnemonics are effective, under what conditions they are effective, which mnemonic components are crucial, the limits to which one's mental capacity can be pushed, and so on. Thus, many of the memory-expert packagers' assertions have come under scientific scrutiny only comparatively recently.

Atkinson's mnemonic keyword method. The direct impetus for the work I will report here comes from Richard Atkinson and his mnemonic keyword method (Atkinson, 1975). Unlike the "mnemonic researchers" who studied subjects' recall of arbitrarily selected or paired stimulus materials, Atkinson observed subjects' performance on a more ecologically valid task, foreign vocabulary learning. Whether such a task is in fact genuinely different from one involving, say, Ebbinghaus nonsense syllables will not be debated here, but at least the foreign language task gives the appearance to various critics of being educationally useful.

Atkinson's keyword method consists of two stages, the acoustic link stage and the imagery link stage. These two stages can be illustrated

using the Spanish word carta, which means (postal) letter. In the acoustic link stage, the student acquires a "keyword", which is a familiar English word that: (a) sounds like a salient part of the foreign word; and (b) ideally, is picturable. For carta, a good keyword is cart. Then, in the imagery link stage, the student must form a visual image in which the keyword and English translation referents are interacting in some manner (not necessarily bizarrely!). Thus, for carta, the student might picture a shopping cart transporting a postal letter, such as in Figure 1. When the student is later asked for the meaning of carta, the keyword cart is evoked, which in turn re-evokes the image of a cart containing a letter. If both components function as expected, the response letter will be produced. Atkinson found that college students applying the keyword method recall more English equivalents when cued with the foreign words, in comparison to rote-learning control subjects.

Atkinson's results come as no great revelation to those acquainted with the theoretical and empirical contributions of Bower, Paivio, Rohwer, and other associative-learning researchers. Consider, for example, the following component operations and underlying principles:

1. Operation: A nonmeaningful nominal stimulus (the foreign word) is converted to a meaningful functional stimulus (the keyword). Principle: Meaningful stimuli are more reliably encoded than non-meaningful stimuli.

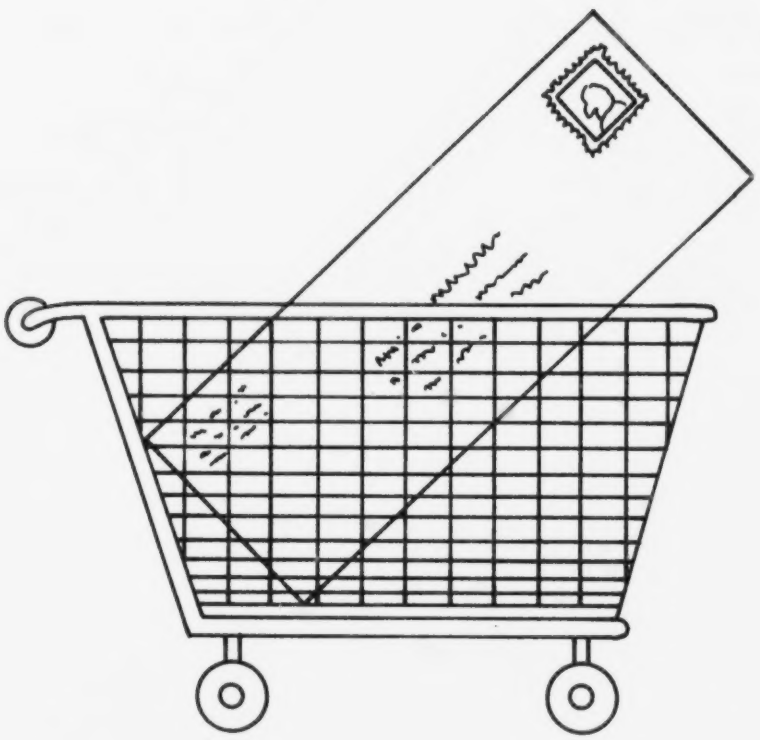

Figure 1. Keyword illustration for foreign vocabulary learning (Pressley & Levin, 1978).

2. Operation: A thematic interaction is constructed between the functional stimulus (the keyword) and the desired response (the English equivalent). Principle: Interacting items are more reliably associated than noninteracting items.

3. Operation: The nominal stimulus (the foreign word) evokes the functional stimulus (the keyword). Principle: The greater the similarity between nominal and functional stimuli, the more reliably will one evoke the other. If the keyword is a salient constituent of the foreign word, this operation will be successful.

4. Operation: The functional stimulus (the keyword) re-evokes the previously produced thematic interaction. Principle: Thematic interactions are reliably retrieved from appropriate cues.

5. Result: The desired response (the English equivalent) is "read off" the interaction.

Support for each of the above principles may be found in the psychological literature. Moreover, careful analyses of the above operations suggest the appropriate modifications of the keyword method that are required to enhance other aspects of foreign vocabulary learning, such as recall of vocabulary words from their translations (Pressley & Levin, in press; Pressley, Levin, Hall, Miller, & Berry, 1980). And as will be demonstrated shortly, similar task analyses permit adaptations and extensions of the keyword method to enhance students' learning of other school curricular content.

That, in fact, is what constitutes the remainder of this report. Rather than relating the numerous foreign language findings that have been reported in the years following Atkinson's (1975) introduction of the keyword method (see Pressley, Levin, & Delaney, Note 4), I will concentrate on other school-learning applications of the method, based

largely on our work with children. By "our" work, I am referring to more than 3 year's worth of collaborative research, primarily with my close associate, Michael Pressley of the University of Western Ontario, and graduate students Jill Berry, Christine McCormick, Gloria Miller, and Linda Shriberg of the University of Wisconsin.

Children's use of the keyword method. Pressley's doctoral dissertation was most instrumental in shaping our thinking about the potential of mnemonic techniques in the classroom. In particular, Pressley (1977a; Pressley & Levin, 1978) adapted Atkinson's keyword method of foreign vocabulary learning for use by elementary school-aged children. The word "adapted" is well chosen here, as I will now explain. Briefly stated, Pressley found that the method works very well, ev. with 7-year-olds, but not in the form that Atkinson had presented. To derive maximum benefits from the method with these children, the experimenter had to display actual line drawings during the imagery link stage, rather than leaving the process of constructing appropriate visual images up to the student (as Atkinson had done). This finding had been fully anticipated on the basis of analogous studies in the cognitive-developmental literature (e.g., Levin, 1976; Pressley, 1977b; Rohwer, 1973).

The obvious message for the applied researcher and curriculum developer, then, is that in the mnemonic domain, as in others, the effectiveness of a particular innovation depends on its suitabiliby to the audience for whom it was intended. This also represents a roundabout way of sneaking in an aptitude-by-treatment-interaction (ATI) notion of sorts, and is an issue that I believe is important

in the mnemonic domain. Debates persist concerning whether or not to have students construct their own images and keywords (Pressley et al., Note 4). In the case of helping children learn school content mnemonically, we have decided to provide them with specially constructed keywords and illustrations for three main reasons. First, deciding upon the appropriate mnemonic components to be applied--and in what sequence--is not always an easy task, as will become apparent in some examples I will discuss shortly. Second, even if the appropriate components are identified and attempted in their optimal order, school-aged children (and, I might add, many adults as well) cannot always invent "good" keywords and "good" mnemonic links. Rather, careful consideration needs to go into particular keyword and interaction selections. With mnemonic illustrations derived from several judges' consensus, and retained or modified on the basis of subsequent pilot testing and item analyses, the resulting products are, on the average, bound to be superior to those generated by a student during the course of learning. Third, even if students were successful at concocting keywords and potential interactions, individual differences in imagery ability would water down the across-the-board effectiveness technique. For all these reasons, in most of our research with children, we have used professionally drawn mnemonic illustrations. Of course, whether and when children can be taught to generate their own effective mnemonics are important instructional issues that must be probed along the way (see, for example, Pressley & Dennis-Rounds, 1980).

Mnemonic Applications

Let me now relate the results of several investigations in which the keyword method has been adapted for and extended to use with

curriculum content other than foreign language vocabulary. Keep in mind that the examples I will provide are intended to illustrate, rather than to exhaust, the potential applications of mnemonic techniques.

English Vocabulary

If the keyword method can improve students' learning of new vocabulary in Spanish, French, Latin, German, Russian, and Malay (Pressley et al., Note 4), why not in English? And, indeed, the method has been successfully applied to teaching English vocabulary, either as a second language to Vietnamese children (Pressley, Note 5) or as a vocabulary builder for native English-speaking children and adults. In the latter area, we have found that college students can improve their definition learning of low frequency English nouns such as carlin (old woman) and poteen (Irish whiskey). In addition: (a) the improvement by far exceeds that associated with other traditional semantic-based alternatives (Pressley, Levin, & Miller, Note 6); (b) learning of the vocabulary word in response to the definition can be improved by the keyword method (Pressley & Levin, in press); and (c) success with the keyword method also shows up on conventional measures of vocabulary comprehension and usage, such as sentence judgment and cloze tasks (Pressley, Levin, & Miller, in press).

The keyword method can also be adapted for teaching new English vocabulary to children. In some earlier foreign language studies, the keyword method had demonstrated its versatility by improving students' learning of vocabulary other than concrete nouns. In two studies it was found that abstract nouns were similarly facilitated (Delaney,

1978; Pressley, Levin, & Miller, Note 7); and in another study, the method improved children's learning of action verbs (Miller, Levin, & Pressley, in press). Recently we found that the keyword method could be successfully applied to English vocabulary words taught in fourth grade, including some relatively complex concepts such as persuade, hesitate, and surplus (Levin, McCormick, Miller, Berry, & Pressley, Note 8). Our keyword method adaptation took the form of two characters engaged in a conversation, as in Figure 2.[1] Several comments about this study should be made.

First, in two experiments, children shown keyword illustrations such as that in Figure 2 learned substantially more definitions than time-equivalent controls who were given the vocabulary word, the definition, and use of the word in context (e.g., "The lady's friend was trying to persuade her to buy a pocketbook"). In one experiment, the keyword method was clearly superior to a highly touted experiential context method (Gipe, 1979).

Second, unlike most other keyword vocabulary-learning studies, the vocabulary items were not chosen on the basis of their being particularly hospitable to keyword method use, in terms of either keywords or meanings. This was assured in the first experiment by having an educator, familiar with the fourth-grade vocabulary curriculum, provide us with a set of difficult-to-acquire vocabulary words; and in the second experiment by randomly selecting items from a previous developed pool used to compare several nonkeyword vocabulary-learning strategies

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[1]Note that the keyword chosen for this example (purse) and the corresponding keyword portion of the vocabulary word (pers) are orthographically different, which might be expected to increase students' spelling errors (see, for example, Pressley, Levin, Nakamura, Hope, Bispo, & Toye, in press). Because vocabulary acquisition per se was the primary focus of this study, no precautionary measures concerning potential misspellings were taken. An alternative mnemonic strategy could have been provided to improve students' spelling of the words (e.g., Negin, 1978), were that of concern.

OH, MARTHA, YOU SHOULD BUY THAT PURSE!
I THINK YOU CAN PERSUADE ME TO BUY IT!
PERSUADE (PURSE) When you talk someone into doing something

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Figure 2. Contextually explicit keyword illustration for English vocabulary learning (Levin et al., Note 8).

(Gipe, 1979). Thus, every effort was made not to bias the item selection process in the keyword method's favor.

Third, in the first experiment, all vocabulary items were verbs that could be enacted by one of the characters in conjunction with the corresponding keyword (e.g., the lady persuading Martha to buy a particular purse). An important point is that we initially developed illustrations that included just the keyword utterance, with the vocabulary word, keyword, and definition at the bottom of the page (see Figure 3). As can be seen, the definition is explicitly stated, and the accompanying keyword illustration provides contextual support for the definition. In keeping with our earlier comments about what seems to work well on paper, however, fourth graders could not profit from such illustrations. In retrospect, it is likely that the degree of inference required in going from picture to meaning was too great for children of this age. This, of course, suggests a testable hypothesis for those interested in the development of inferential skills: With older children and adolescents, perhaps inference-demanding illustrations of this kind would be beneficial. But would they ever be as effective as the explicit ones?

Finally, the keyword facilitation observed in this study cannot be attributed to pictorial context per se. Compare, for example, the illustrations in Figures 4 and 5, that were used in our second experiment to teach the meaning of surplus. In Figure 4, an appropriate keyword (syrup) accompanies the context; in Figure 5, a comparable

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PERSUADE (PURSE) When you talk someone into doing something

Figure 3. Contextually implicit keyword illustration for English vocabulary learning (Levin et al., Note 8).

SURPLUS (SYRUP) having some left over, having more than was needed

26

27

Figure 4. Contextually explicit keyword illustration for English vocabulary learning (Levin et al., Note 8).

Should you use so much ketchup ?
It's OK; we have a SURPLUS of it in the cupboard
TCHUP
KETCHUP
KETCHUP
KETCHUP
KETCHUP
SURPLUS having some left over, having more than was needed

Figure 5. Contextually explicit nonkeyword illustration for English vocabulary learning (Levin et al., Note 8).

contextual illustration is used, but without a keyword. Keyword illustrations greatly improved vocabulary learning; nonkeyword illustrations produced no effect whatsoever. Thus, as has also been demonstrated with regard to remembering names and faces mnemonically (McCarty, 1980), the keyword is a vital link in the chain. Without it, performance deteriorates.

In sum, then, our adaptation of the keyword method clearly improves children's learning of new vocabulary. Additional research is required to test the method against other vocabulary-learning strategies (Johnson & Pearson, 1978), and to assess its potential for use in diverse student populations.

Science and Social Studies Content

There is no reason why the keyword method should not improve students' learning of any new vocabulary, inlcuding the highly technical terms encountered in science courses. Though few in number, such extensions have proven successful. The method has been applied to students' learning of unfamiliar medical terminology (Vaughn, 1974; Jones & Hall, Note 9). It has also been explored in the context of remembering functions of various biochemicals (Pizza, Note 10). In the area of social studies, students have learned to associate cities with their products (Pressley & Dennis-Rounds, 1980) and famous people with their accomplishments (Jones & Hall, Note 9) according to the keyword method. I will describe a promising extension of such applications shortly. First, however, I wish to discuss two other social studies applications that expand the original version of the keyword method.

States and capitals. In one study, fourth and fifth graders learned the capital cities of the United States using what we called a dual keyword approach (Levin, Shriberg, Miller, McCormick, & Levin, 1980). "Dual" comes from the fact that two acoustic links, rather than Atkinson's one, had to be acquired before the imagery link was provided. Let me illustrate, using one of my favorites, Annapolis, Maryland. In the first of a three-stage process, students were taught keywords for the states, such that when a state was given (Maryland) they could supply the keyword (marry). Then, since the criterion task required that the student supply the capital in response to a state name, in the second stage we gave students the reverse type of keyword practice with the capitals. That is, they had to respond with the capital (Annapolis) when given a keyword (apple). Finally, in the third stage, an illustration such as in Figure 6 was provided. In comparison to a very liberal control condition that allowed unrestricted study and self-testing, keyword subjects were better at remembering the capitals. This was true on an immediate test, but especially so on a surprise retest three days later. As you might have begun to infer by now, keyword illustrations are quite memorable! Let me make a few additional comments related to this study.

As we discovered in a follow-up experiment, the most difficult part of the process appears to be retrieval of typically unfamiliar names such as Annapolis, Montpelier, Topeka, and so on. Thus, some type of prior acquaintance with the names is crucial for realizing maximum

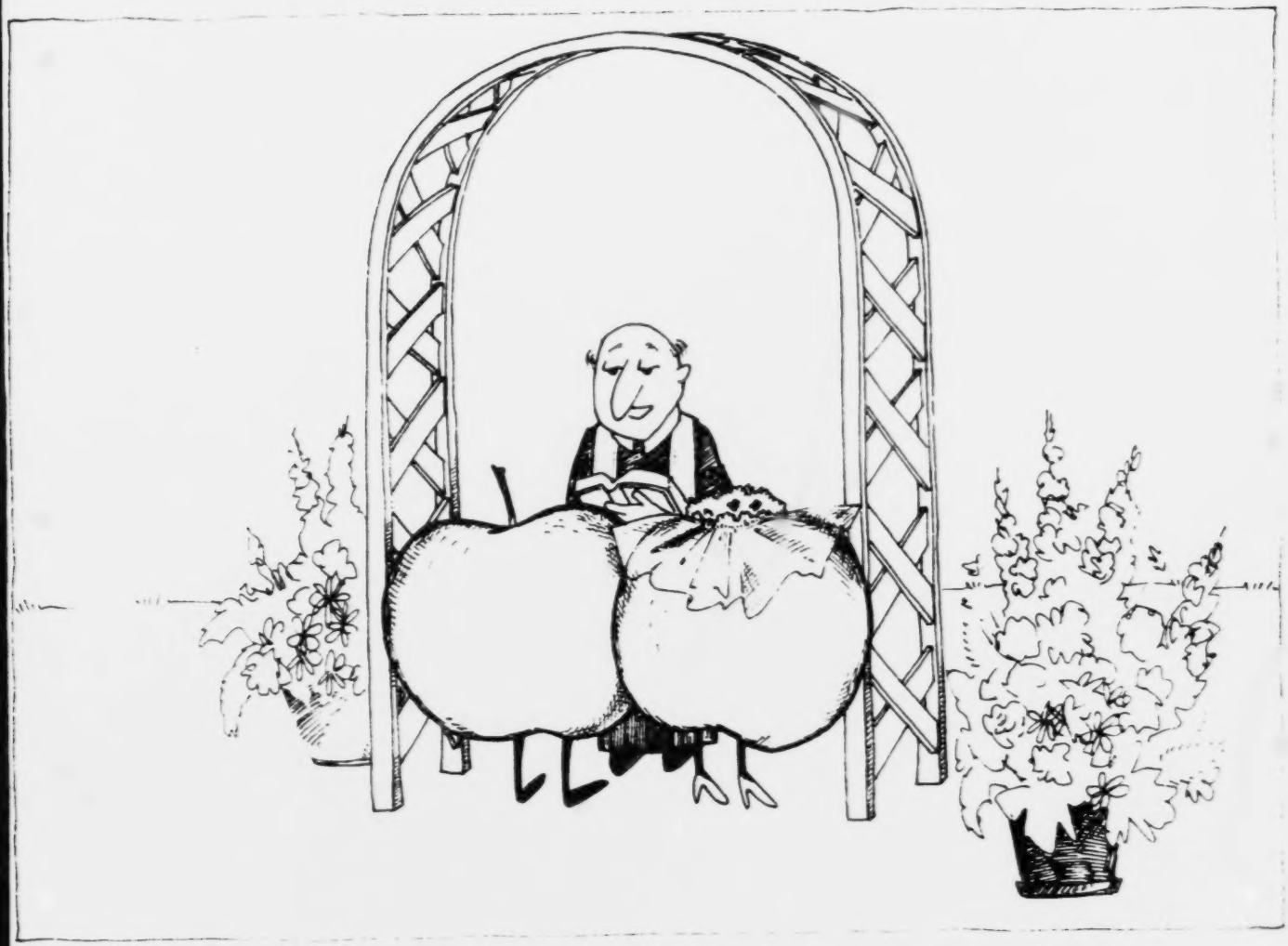

Figure 6. Dual keyword illustration for learning the states and capitals (Levin et al., 1980).

returns. The problem is, of course, the same as with students acquiring unfamiliar vocabulary words and, as has been found in that context (Pressley & Levin, in press), success occurs only when the vocabulary word can be reliably produced in response to the keyword (i.e., the reverse of previous Operation 3). In this regard, it is interesting to note that in the first experiment, where the capitals' names had been mentioned as part of the regular social studies curriculum throughout the school year, the effect of the keyword method was more pronounced than in the second experiment, where no intentional classroom exposure to the capitals' names occurred.

Another issue is related to the just mentioned response-learning problem. In situations where prefamiliarization with the desired responses is impractical, another approach could be considered. Multiple keywords could be provided for each response, so that recall of the keyword string would strongly suggest the corresponding response. Thus, for example, rather than use sack as a keyword for Sacramento (as we have done), one could use the multiple keywords, sack-of-mint-toe. This is exactly what the exbasketball-pro-turned-memory-pro, Jerry Lucas, has done in his commercially available book (Lucas, 1978). The corresponding illustration that Lucas gives for this capital, combined with the multiply keyworded state, call-fern-U, is shown in Figure 7. Clearly, as can be seen from this picture, what one gains in acoustic correspondence one loses in simplicity and sensibility. Illustrations of this kind may also create learning problems for

The capital of CALIFORNIA is SACRAMENTO. The substitute word for CALIFORNIA is CALL-FERN-"U." The substitute word for SACRAMENTO is SACK-OF-MINT-TOE.

CALIFORNIA
CALL-FERN-"U"

SACRAMENTO
SACK-OF-MINT-TOE

A man is CALLing a FERN with a letter "U" next to it while balancing a SACK-OF-MINT on his TOE.

Figure 7. Multiply keyworded illustration for learning the states and capitals (Lucas, 1978).

children as indicated by a recently completed study, where Lucas's materials did not function effectively. Thus, as was mentioned earlier, not all that glitters in one's mind is mined in another's memory. Our own simple rendition of Sacramento, California, is illustrated in Figure 8. Note that we used two keywords for California (call phone), but they certainly seem less complex than the three used by Lucas.

In the name of fair play, however--at least temporarily--it should be mentioned that in our experiment, the students were shown the Lucas keyword illustrations according to the directions in his book--in one stage, without separate keyword learning. Our own materials proved similarly ineffective when our recommended three-stage process was reduced to one. What we can say, then, is that our materials are effective when used in the prescribed fashion; Lucas's are not. Whether Lucas's method suffers from a materials or a procedural breakdown is currently under investigation. These results also indicate that with a fixed amount of time available, it is better to separate physically the acoustic link stage from the imagery link stage, at least where children are concerned. In contrast to Atkinson's and our own research with adults, this separation of component mnemonic processes has been employed in all of our work with children. The rationale behind mnemonic component separation should become even more apparent from a social studies application that will be described shortly.[2]

One unique feature of our initial states-and-capitals experiment was that we used a crossover design. In that experiment, students learned

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[2]The notion of utilizing separate alternating stages seems promising (Horowitz & Gordon, 1972), but has not yet been considered in a mnemonic context.

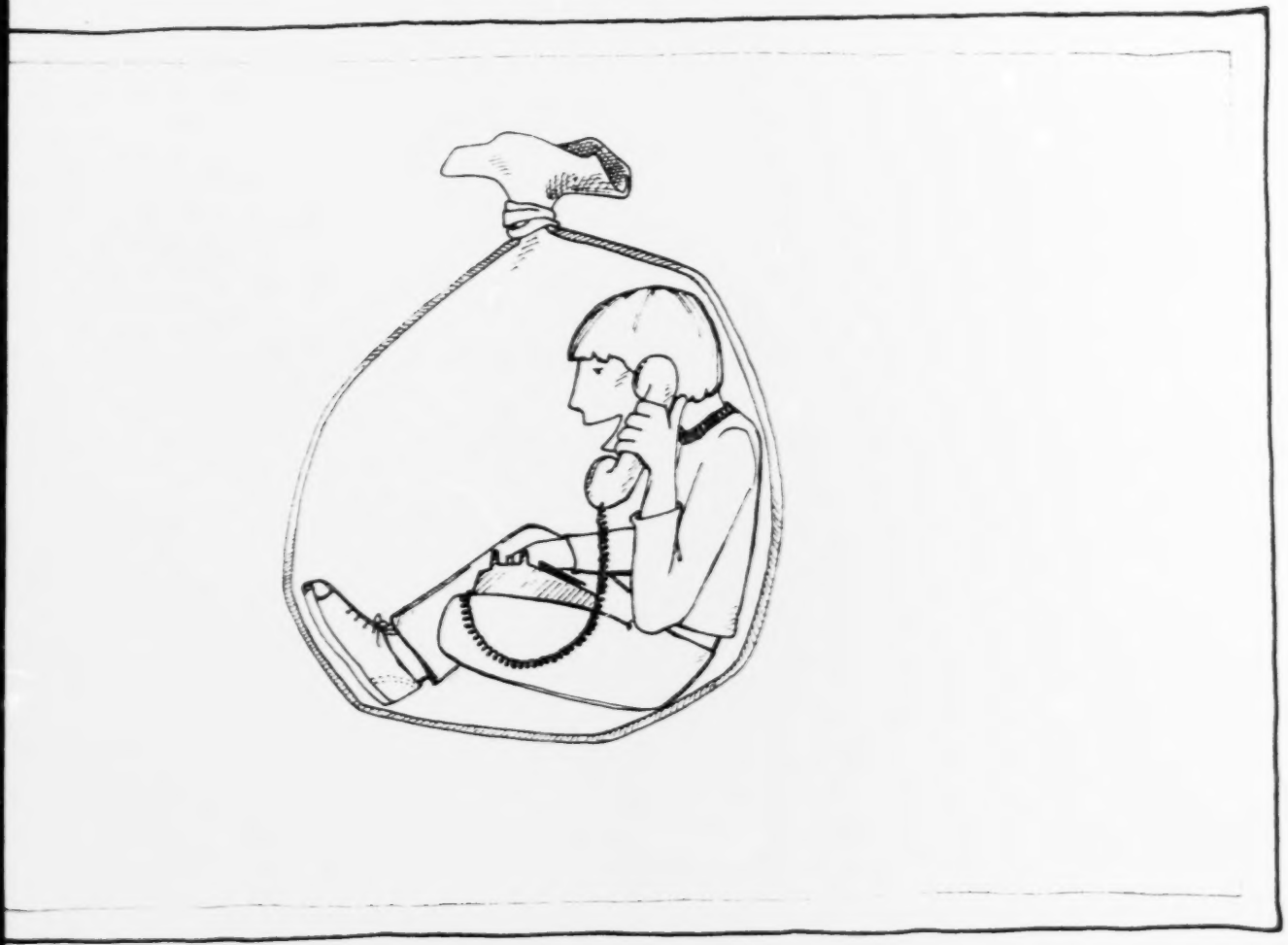

Figure 8. Dual keyword illustration for learning the states and capitals (Levin et al., 1980).

the capitals of about a dozen states during one session and another dozen in a session three days later. The keyword subjects of Session 1 became control subjects in Session 2, and vice versa. By switching conditions between sessions, we could provide all students with keyword method instruction (an educational concern), as well as look for evidence of strategy maintenance from one session to the next (a research concern). That is, if students who were taught the keyword method in Session 1 continued to use the method when left to their own devices, then that should show up in their Session 2 performance. However, it did not; the advantage of students given explicit keyword instruction was comparable in both sessions. This does not mean that previously instructed keyword subjects did not attempt to apply the keyword method in Session 2. In fact, some did, but they did so ineffectively, which underscores my previous point about the likely difficulties encountered by children without the benefit of highly structured materials (experimenter-provided keywords and illustrations).

We are currently extending our mnemonic research in this area to encompass both map-geographical information and the distinguishing economic resource characteristics of the various states. Here, as well as in the other research discussed, one of the most intriguing questions centers on the number of mnemonic links that can be effectively built into a particular content domain. The possibilities multiply when, in addition to the keyword method, other mnemonic systems are included. Allow me to illustrate.

U.S. presidents. "Who was President No. 10?" We have all encountered such questions, with varying degrees of embarrassment, along our educational and daily paths. Apart from the most overlearned (Nos. 1 and 16), the most recent (Nos. 37, 38, and 39), and the most-likely-to-become-trivia-items

(No. 13 = Millard Fillmore), the names and numbers of most of our presidents cannot be rattled off with great alacrity or confidence. That is, not until now could they. We have developed some mnemonic "presidential" materials, and tried them out with eighth-grade students (Levin, McCormick, & Dretzke, Note 11). In that study, we found that the materials were enjoyable and, more importantly, effective. On two different lists of 18 presidents, mnemonic subjects outperformed self-study control subjects, whether they were asked for presidents' names given numbers, or numbers given names. Now let's see how they did it.

The pictorial materials we developed differ from the exclusively keyworded materials discussed so far. Our illustrations essentially combine three different mnemonic systems: keyword, pegword, and loci. Keywords represent the presidents' names, whereas pegwords and familiar loci represent the numbers 1 to 40. With the pegword system, the numbers 1 to 10 are replaced by picturable rhyming words (i.e., one is a bun, two is a shoe, etc.). Seasonal loci represent decades of numbers (i.e., 1 to 10 is a spring garden scene, 11 to 20 is a summer beach scene, 21 to 30 is a fall football scene, and 31 to 40 is a winter snow scene). With this approach, each president (keyword) is made to interact with a particular number (pegword placed in a specific locus). Thus, for example, to remember that Tyler was the 10th president, the student must code the number 10 as a hen in a garden scene (10 is a hen and spring represents the first 10 numbers). Further, he or she must learn that the keyword for Tyler is tie. Put these three items together and one derives the illustration that is Figure 9. To

show how the seasonal locus operator works, consider our 20th president, Garfield. Number 20 is also represented as a hen, but this time in a beach scene. With guard as a keyword for Garfield, we have Figure 10.

As with the states-and-capitals materials, we have extended these to incorporate additional related content. As a first step, we are providing biographical information about the presidents, in a manner similar to that used in a study I will mention shortly. Our "presidential" materials also lend themselves to some interesting cognitive process analyses as well. In one study, we are recording students' serial position errors and response latencies to the question "What number was President ____?" to permit inferences about the nature of organizational process differences associated with mnemonic and control subjects. To the extent that control subjects cumulatively rehearse list parts, the correspondence between the error and latency measures and the presidents' actual serial order should be greater than among mnemonic subjects. We are also using response latencies to study inter- and intra-individual differences in relation to subjects' self-reports. This is but one example of how an educationally valid task can be applied to theoretical issues of interest to educational psychologists.

The Mnemonic '80s: Keywords in the Classroom?

If we want to find keywords in the classroom in the '1980s, then we'd better get moving. Let me list my "top 10" reasons for why I would like to see this happen. I'll even do my best to help you remember all ten.

10 John TYLER

hen tie

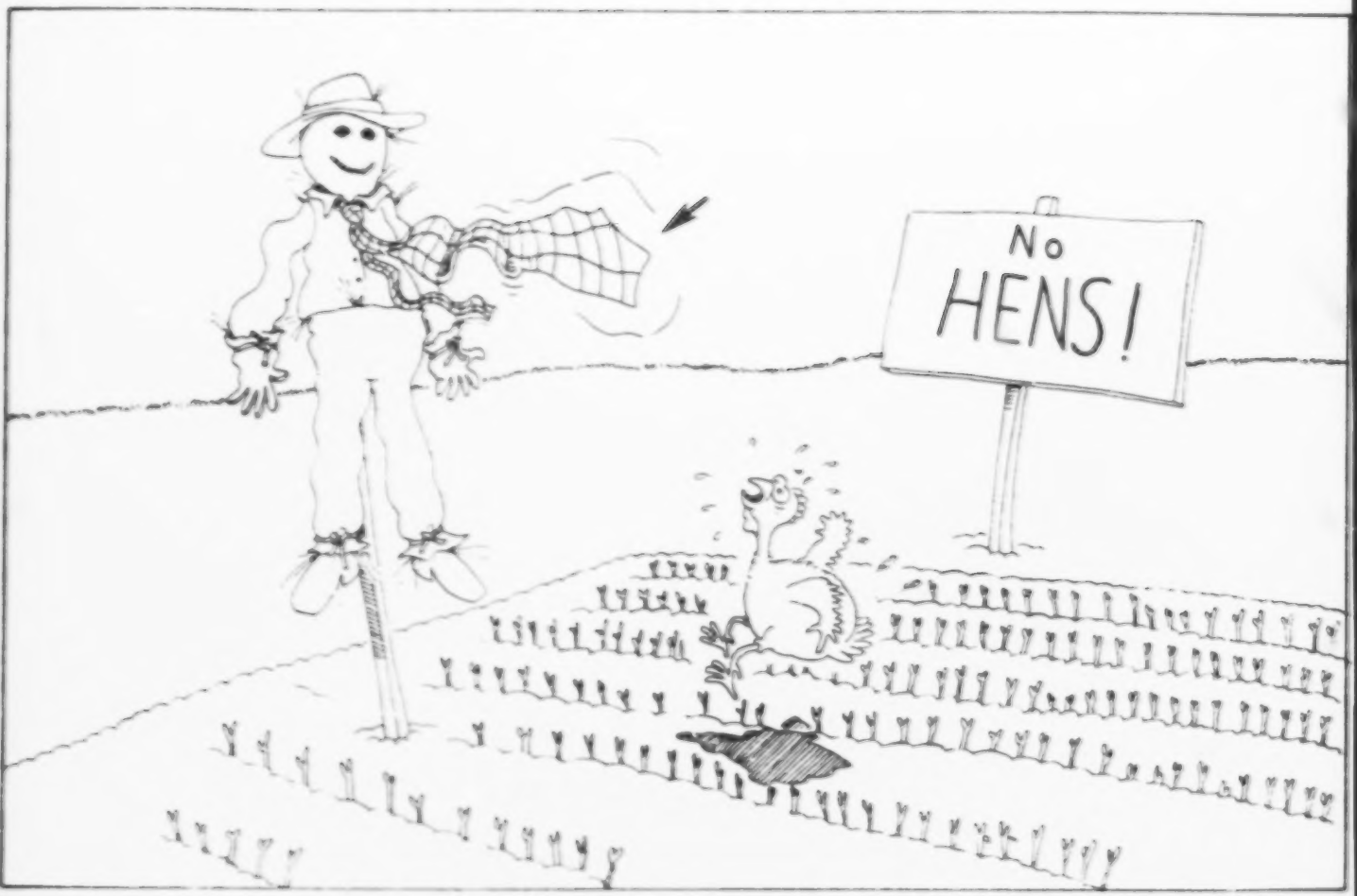

Figure 9. Combined mnemonic illustration for learning the presidents (Levin et al., Note 11).

20 James GARFIELD

hen guard

Figure 10. Combined mnemonic illustration for learning the presidents (Levin et al., Note 11).

A Case for Keywords in the Classroom

I believe in mnemonic curricula, and with the assistance of the following illustrations I will explain why.

1. Mnemonics are proven winners. The vast majority of relevant studies in the research literature clearly support this statement. Students taught according to mnemonic techniques remember more information in comparison to nonmnemonic control students. In the few studies where mnemonic techniques have not helped, they have not hurt either (i.e., there has been no significant difference between mnemonic and control subjects).

2. Mnemonic effects are potent and durable. A "meta-analysis" (Glass, 1977) of the same literature reveals that the positive mnemonic effects obtained are usually significant in more than just a statistical sense. That is, they are generally sizable effects that hold up, or even increase, over time. Thus, we are not talking about tiny treatment differences here. Indeed, the more difficult the material is to remember, the more likley it appears that large mnemonic effects will emerge (Levin, in press).

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3. Mnemonics are versatile.

The various school content applications that I have indicated here should help persuade you of that. But, apart from remembering lists and unconnected pieces of information, do mnemonics have any other educational value? I believe that their full potential has yet to be realized in other school-learning activities held in esteem by most educators. Take, for example, expository prose passages in the content areas of science and social studies.

We have only begun to explore this important application but, based on the results of our initial work, have great expectations for the future. Our initial series of three experiments (Levin, Note 12) was prompted by the names-and-accomplishments study of Jones and Hall (Note 8). Unlike the stimulus materials in that study, however, which consisted of simple unconnected name-accomplishment pairs, in our study people's names and their accomplishments were embedded in short prose passages. Use of the keyword method (either via experimenter-provided pictures or student-generated images) enabled the eighth graders of our study to recall far more names and accomplishments in comparison to control students. Our eventual goal is to equip students with an armament of mnemonic techniques which, when used in conjunction with other popular prose comprehension strategies such as organizing, questioning, and summarizing (e.g., Levin & Pressley, in press), will enhance students' recall of difficult-to-remember, nonnarrative prose.

Mnemonic strategies appropriate for what would be classified as "abstract" prose passages are also being developed. In these areas, it is important to emphasize that mnemonic strategies and materials are viewed not as competitors to existing comprehension-enhancing procedures, but rather as companions that will foster long-term retention and use of pertinent text information.

4. Mnemonic techniques can work in a classroom context. Although a number of caveats appear to be associated with this statement, two recent experiments by Levin, Pressley, McCormick, Miller, and Shriberg (1979) have shown that large keyword effects can be produced when children learn foreign vocabulary in either small groups or classroom-sized groups.

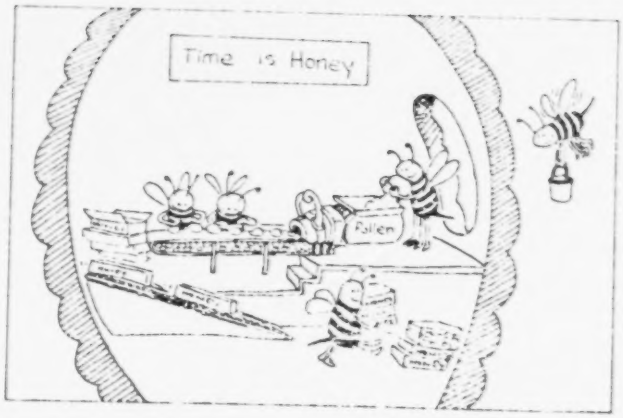
Thus, the fear that individualized instruction in a one-to-one setting is required to obtain mnemonic facilitation is unfounded empirically. Of course, there may well be treatment implementation problems associated with groups that do not occur with individual treatment administrations. These implementation problems need to be considered in the context of the particular student population on hand (see Levin et al., 1979).

5. Mnemonics are time efficient. In our studies to date, we have rarely devoted more than 15 or 20 minutes worth of instructional time in the use of the particular mnemonic technique under investigation. Despite this minimal time investment, as has been noted throughout

the paper, impressive learning gains have been observed. Of course, the more one transfers the creation of relevant mnemonics from the experimenter to the student, the more time it would take to yield comparable benefits. On the other hand, what price is a relatively heavy time investment if a skill is being acquired that should transfer to the efficient processing of information in other educational and real-world domains (e.g., Pressley & Dennis-Rounds, 1980)? The real intent of this point, however, is that whatever the amount of time spent in mastering a mnemonic system, it will be spent <u>efficiently</u>, in that high returns per unit of investment are expected.

5 Mnemonics are time efficient

hive



6. <u>Use of mnemonic techniques will not impede the acquisition of other valued skills</u>. Critics have argued that reliance on mnemonics will keep students from attaining other lofty educational goals, such as "real" understanding and critical thinking. As Higbee (1978) has persuasively argued, however, this must really be viewed as one of several "pseudo-limitations" of mnemonic techniques. Indeed, with the previous time efficiency point in mind, quite the reverse assumption is made by Higbee:

6 Use of mnemonic techniques will not impede the acquisition of other valued skills

skiers

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> [With mnemonic techniques, students] can memorize the necessary routine things more efficiently, and thus free their minds to spend more time on tasks that involve understanding and reasoning. [They can also] better remember the facts they use for understanding and reasoning; even tasks that involve reasoning and understanding require that you remember the facts in order to reason with them and understand them... (p. 150).

Such arguments are consistent with my previously mentioned vision that memory- and comprehension-enhancing strategies for prose passages can coexist in peaceful harmony and, in fact, be mutually beneficial. More to the point, the data we have so far suggest that, if anything, mnemonic techniques serve to increase students' comprehension (Pressley, Levin, & Miller, in press).

7. Mnemonics may help to foster certain valued skills. Apart from the preliminary comprehension data just mentioned, at least two other valued cognitive skills would be expected to benefit from the acquisition and use of mnemonic techniques. One of these is creativity, a component likely to be involved in constructing

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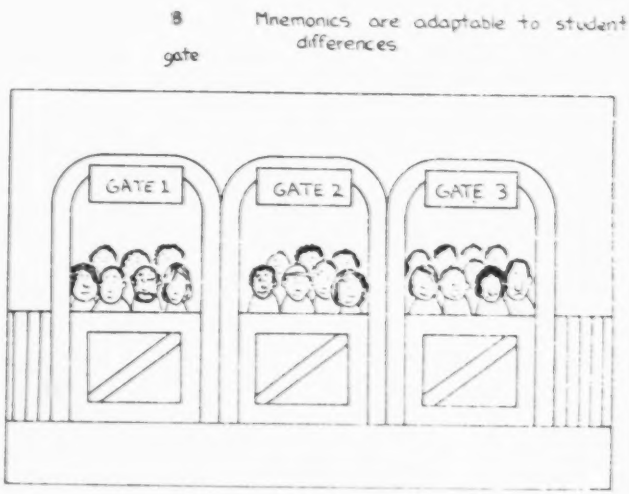
mnemonic devices that "work." A tentative experimental hypothesis in this regard, then, is that more creative students generate more effective mnemonics. The flip side of this, and the one relevant to the present discussion, is that instruction and practice related to effective mnemonic generation will have positive consequences for students' creativity in other domains. Along similar lines, mnemonic construction and efficient retrieval demand an element of systematicity and, as such, this aspect of logical thinking may be positively affected as well.

8. Mnemonics are adaptable to student differences. With memory adjuncts, it may be the case that some students "need" mnemonics more than others. Perhaps they should be taught only to the slowest learners. I think that would be a mistake, however, as we found out in a recent study where students with exceptional foreign vocabulary learning ability benefited greatly from using Atkinson's keyword method (Pressley, Levin, Nakamura, Hope, Bispo, & Toye, in press). Though it may come as a surprise, good learners do not always learn things in the most efficient manner, nor do they always put forth the effort needed to apply an effective strategy. By alerting all students to mnemonic possibilities, and hopefully getting various strategies to become second nature to them, memorial benefits are bound to occur, even for the best learners.



But what about the student differences I have mentioned? Mnemonics are not an either-or proposition. The nature and number of mnemonic strategies taught to students should vary according to specific abilities and needs. Thus, although we specifically considered only the keyword method, the pegword method, and the method of loci here, others such as the "hook" method (Paivio & Desrochers, 1979) and various mnemonic counting systems (e.g., Lorayne & Lucas, 1974) may be suitable for some students in certain situations. Similarly, we have focused exclusively on pictorial mnemonic techniques, although verbal analogues to these can be devised (e.g., Pressley et al., Note 6). Other verbal approaches, such as "first letter" mnemonics (e.g., Morris & Cook, 1978) and "crossword" mnemonics (Bull, Note 13) have been researched, and may prove useful for students with comparatively better verbal than imagery facility. The point to be made is simply that some students may require both different mnemonic components and varieties than others and, fortunately, such mnemonic adaptations are possible.

9. Most children enjoy using mnemonics. If there is any place for subjective appeals in my listing, let it be here. It is difficult to convey the positive reactions of the students we have observed. More than just enjoying the particular mnemonic illustrations we have provided, students have invariably exhibited an enthusiasm and sense of accomplishment upon "discovering" a new technique to improve their memories. The improvement is immediate and obvious to almost all who have tried our mnemonics. Of course, mastery of mnemonic systems--just like

mastery of other worthwhile skills--is not going to happen quickly and automatically. Deriving maximum benefits from mnemonic systems requires an overlearning of the specific keywords, pegwords, loci, hooks, or whatever; in other words, a student must be willing to make a serious energy commitment toward learning a system and its components. As mentioned before, however, the time and effort required initially is an investment well worth making.

9 Most children enjoy using mnemonics
lion

10. Many teachers believe in the value of mnemonics. This statement is based on the comments of a small national sample of elementary school teachers (Borton, Note 13). Many teachers are fascinated by mnemonic methods of teaching vocabulary and other school content, and are eager to try them in their classrooms. Of course, some teachers are far from favorably impressed by mnemonics, offering the previously stated "lofty educational goals" argument and its companion "crutch" argument. The crutch pseudo-limitation--that students will become excessively dependent on mnemonic "tricks"--is unfounded empirically and can be countered on logical grounds. A poignant comment addressing the issue is offered by Higbee (1978):

10 Many teachers believe in the value of mnemonics
hen

> An irony of the crutch criticism is that it serves as the basis for two conflicting criticisms. On the one hand, the critic says that you cannot remember the material without the crutch (meaning that you are lost if you forget the crutch). On the other hand, the critic says that you become too dependent on the crutch for remembering the material (meaning that you cannot forget the crutch) (p. 151).

As for the "tricks" notion, maybe teachers should start thinking of training their students to be magicians. Indeed, teachers will be amazed with the amount of curriculum content their students can learn and remember with the use of mnemonic strategies. Hopefully, some of the negative teacher reactions will change as more and more positive scientific evidence comes in and is appropriately communicated.

Concluding Comment

We educational psychologists can recall with varying degrees of clarity the remarkable advances that have been made in our discipline during the "programmed instruction '50s," the "mathemagenic '60s," and the "schema '70s." In some instances, we can even point with pride to the positive impact that the innovations nurtured in these decades have had on learning in classrooms. Now it is clear that a new day of "information processing" is dawning. But before the magic carpet arrives to whisk us away into the "cognitive science" era, I have one small favor to ask: Would you kindly save at least a fraction of your M space for the "mnemonic '80s"?

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